

REMARKS

5 In response to the Examiner's Action mailed on December 18, 2003, claims 15 to 42 are amended. The applicants hereby respectfully request that the patent application be reconsidered.

An item-by-item response to Examiner's objections or rejections is provided in the followings:

10 I. **Rejection of Claims Under 35 USC § 103**

15 The Examiner rejects claims 15 to 17 and 32 under 35 USC § 103(a) as being unpatentable over Robbins in view o in view of Coates et al. US PG-Pub 2002/0075131.

20 According to the Examiner, Robbins discloses in fig. 7 a resistor array comprising a plurality of resistors 234 comprising a base; a plurality of electrodes 222 composed of conductive material disposed directly on said base wherein said base between every two of said electrodes having a precisely controlled distance for providing a precisely defined resistance for each of said resistors, but does not disclose a metallic bulk base. Coates et al disclose (see page 2, par. 0021 and claim 5) an embedded resistor disposed on metallic bulk base. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to incorporate the teaching of Coates et al with Robbins' device, since that would not only provide a stronger support system but also a better heat dissipation. According to the Examiner, as to claim 16, Robbins discloses at least an electrode layer of said conductive material disposed on each of said electrodes to form an electrode for each of said electrodes. As to claim 17, according to the Examiner, Robbins discloses a plurality of scribing lines disposed between said resistors for scribing said

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resistor array into a plurality of resistors each comprising at least two electrodes.

5 In response to Examiner's rejections, the Applicants would first like to respectfully draw the Examiner's attention to the following four Paragraphs, i.e., [0013], [0015], [0019], and [0033] and also Claim 1 from Coates et. al.

10 [0013] The material systems hereinafter described were **cermets which used refractory metals with SiO₂ as the dielectric. The depositions were performed by either co-sputtering a cermet and a metal target or by single sputtering a composite ceramic/metal target.** The W/SiO_x material, the primary material investigated, was demonstrated to provide a sheet resistance nearly two orders of magnitude larger than conventional tantalum nitride thin film resistors.

15 [0015] Prototypes of a current sense module have been fabricated using the herein described resistors as seen in FIG. 2. The final size of the current sense multichip module using **embedded passives** was 47% smaller than the original hybrid board area that it replaced. (See FIG. 3).

20 [0019] For use in high density interconnect substrates, conventional printed wiring boards or MCM-LS, Cu foil is first pre-cleaned (see detailed Cu foil pre-clean procedure below) then placed in the sputtering chamber. An ion clean is then performed, followed by **deposition of the resistor material onto the Cu foil. The W/SiO_x coated Cu foil can then be directly inserted into the typical printed wiring board (PWB) process (see detailed process flow for resistors on Cu/FR-4, below).**

25 [0033] **Bond Cu--W/SiO_x samples to a fire retardant epoxy resin/class cloth laminate (FR-4)** (with the W/SiO_x side towards the FR-4 using Allied Signal noflow epoxy prepreg.

Claim 1. An embedded resistor comprising a thin film cermet material deposited by sputtering on a substrate and having a nearly zero TCR, said thin film cermet material comprising M_xSiO_z , where M=W or Ta

5 Based on these descriptions:

- 1) The "Title" of the invention by Coates et al. is the cermet thin film resistors. Coat's resistors are formed as thin films of materials called cermets. The "cermets are a mixtures of metal and insulator materials (Paragraph 0012) by sputtering M_xSiO_z on a substrate, e.g., copper. Therefore, Coates does not disclose a resistor that has a metallic bulk base. The resistor of Coates is a cermet resistor NOT a metallic bulk-base resistor as directed by the amended claims 15-42.
- 10 2) The resistors disclosed by Coates are "embedded" resistors. The embedded resistors do not use electrodes. Instead, Coates' embedded resistors are bonded into the circuits as shown in Fig. 2 as that described in paragraphs [0015] and [0033].
- 15 3) Coates actual teaches away from the structure and manufacturing method of this invention. Since Coates teaches embedded resistors, Coates' resistors have no electrodes, and it teaches away from the configuration of the resistors of this invention that have controlled distance between the electrodes.
- 20 4) Coates teaches the control of the resistance by a sputtering process, therefore, Coates teaches away from the method of this invention by controlling the distance between the electrodes to precisely control the resistance as that directed by the amended claims.
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Based on these reasons, the independent claims are amended to more clearly distinguish from Coates and Robbins. The amended claim 15 is amended to direct to a resistor array that includes:
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a) a plurality of resistors each comprising a metallic bulk base;

- 5 b) a plurality of electrodes composed of conductive material disposed directly on said metallic bulk base **for connecting each of said resistors to external circuits** wherein said metallic bulk base between every two of said electrodes having a precisely controlled distance for providing a precisely defined resistance for each of said resistors.

10 As discussed above, a combination of Coates and Robbins would not be sufficient for a person of ordinary skill to devise a resistor array or a resistor as now directed by the claims as now amended. Actually, a combination of Coates and Robbins would suggest the use of sputtering to increase the resistance of Robbins. Furthermore, a person of ordinary skill would not refer to Coates for improvements on Robbins' resistors since Coates' resistors are embedded resistors and do not have electrodes. The 15 application and manufacturing processes are quite different between Coates and Robbins. For these reasons, the claims as amended now would be new and not obvious under the disclosure of Robbins and Coates.

20 The Examiner further rejects claim 31 under 35 U.S.C. 103(a) as being unpatentable over Robbins US No. 4788,523 in view of Coates et al. US PG-Pub 2002/0075131. According to the Examiner, Robbins discloses in fig. 7 a resistor comprising a plurality of resistors 234 comprising a base; at least electrodes 222 composed of conductive material disposed directly on said base wherein said base 25 between said two of said electrodes having a precisely controlled distance for providing a precisely defined resistance for each of said resistor, but does not disclose a metallic bulk base. Coates et al disclose (see page 2, par. 0021 and claim 5) an embedded resistor disposed on metallic bulk base. Therefore, it would have obvious to one skilled in the art at the time the invention was made to incorporate the teaching of Coates et al with Robbins' device, since 30

that would not only provide a stronger support system but also a better heat dissipation.

5 The Examiner further rejects claims 18 and 32 under 35 U.S.C. 103(a) as being unpatentable over Robbins in view of Coates et al. as applied to claims 15 and 30 above, and further in view of Thomas et al. (J. Vac. Sci. Technol., Vol. 13, No. 1, Jan/Feb. 1976). According to the Examiner, the combined references disclose all the claimed 10 subject matter but do not specifically disclose a nickel-copper alloy metallic material. Thomas et al. disclose in fig. 2 a low TCR metallic material composed of a metal plate comprising a nickel-copper alloy. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to use a nickel-copper alloy metallic material, since having a metallic material comprising same material 15 as a resistor/electrode would save material thereby reducing cost.

20 The Examiner further rejects 20-22 and 34-36 under 35 U.S.C. 103(a) as being unpatentable over Robbins in view of Coates et al. as applied to claims 15 and 30 above, and further in view Sone et al. (JP 2000-173801). According to the Examiner, The combined references fail to specifically disclose resistors having resistance ranging 25 between one milli-ohm to ohm. Sone et al disclose in figs. 1-10 plurality of electrode columns disposed on a metal plate having a precisely defined position for providing precisely defined resistance for each resistors. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to dispose metal plate having a precisely defined position for providing precisely defined resistance for each resistors, since it has been held that where the general conditions of a claim are disclosed in the 30 prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233. As to claims 21, 22, 35 and 36, Sone et al disclose low resistance resistors could be

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achieved by adjusting dimensions of certain elements of the device. Robins discloses a length of a resistor of about 2.54 mm. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to use electrodes and resistors of a suitable dimensions, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

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The Examiner further rejects claims 19 and 33 under 35 U.S.C. 103(a) as being unpatentable over Robbins in view of Coates et al. as applied to claims 15 and 30 above, and further in view Shimada (JP 8-22903). According to the Examiner, the combined references fail to specifically disclose an electrode layer disposed on each of said electrodes comprising a copper layer and a tin-lead alloy layer on each of said electrode column. Shimada discloses an electrode layer disposed on each of electrode columns 2 comprising a copper layer 7 and a tin-lead alloy layer 9 on each of said electrode columns. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to employ a copper layer and a tin-lead alloy layer on each of said electrode columns, since that would control solder wetting degradation and improves background surface of nickel plating.

The Examiner further rejects claims 23-25 and 31 under 35 U.S.C. 103(a) as being unpatentable over Robbins in view of Coates et al and Thomas et al, (J. Vac. Sci. Technol., Vol. 13, No. 1, Jan/Feb. 1976). According to the Examiner, Robbins discloses in fig. 7 a resistor array comprising a plurality of resistors 234 each comprising a base; a plurality of column-shaped electrodes disposed directly on said base and having a precisely controlled distance for providing a precisely defined resistance for each of said resistor, but does not

disclose a metallic bulk base or electroplated electrodes. Coates et al disclose (see page 2, par. 0021 and claim 5) embedded resistors disposed on metallic bulk base. Thomas et al disclose electroplated electrodes composed of low TCR metallic material. Therefore, it
5 would have obvious to one skilled in the art at the time the invention was made to incorporate the teaching of Coates et al with Robbins device, since that would not only provide a stronger support system but also a better heat dissipation. It would have been obvious to one skilled in the art at the time the invention was made to use
10 electroplated electrodes, since that would provide the capability of reducing a conductor resistance.. As to claim 24, Robbins discloses a plurality of scribing lines disposed between said resistors for scribing said resistor array into a plurality of resistors each comprising at least two electrodes. As to claim 25, Thomas et al.
15 disclose in fig. 2 a metallic material composed of a metal plate comprising a nickel-copper alloy. As to claim 31, Robbins discloses at least an electrode layer of said conductive material disposed on each of said electrode to form an electrode for each of said electrode columns.

20 The Examiner further rejects claims 37 and 38 under 35 U.S.C. 103(a) as being unpatentable over Robbins in view of Coates et al and Thomas et al. (J. Vac. Sci. Technol., Vol. 13, No. 1, Jan/Feb. 1976). According to the Examiner, Robbins discloses in fig. 7 a
25 resistor comprising a plurality of resistors 234 each comprising a base; at least two column-shaped electrodes 222 disposed directly on said base and having a precisely controlled distance for providing a precisely defined resistance for each of said resistor, but does not disclose a metallic bulk base or electroplated electrodes. Coates et al disclose (see page 2, par. 0021 and claim 5) an embedded resistor disposed on metallic bulk base. Thomas et al disclose electroplated electrodes composed of low TCR metallic material. Therefore, it
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would have obvious to one skilled in the art at the time the invention was made to incorporate the teaching of Coates et al with Robbins' device, since that would not only provide a stronger support system but also a better heat dissipation. It would have been obvious to one skilled in the art at the time the invention was made to use electroplated electrodes, since that would provide the capability of reducing a conductor resistance. As to claim 38, Thomas et al. disclose in fig. 2 metallic material composed of a metal plate comprising a nickel-copper alloy.

The Examiner further rejects claims 27-29 and 40-42 under 35 U.S.C. 103(a) as being unpatentable over Robbins in view of Coates et al and Thomas et al as applied to claims 23 and 37 above, and further in view of Sane et al. (JP 2000-173801). According to the Examiner, the combined references fail to specifically disclose resistors having resistance ranging between one milli-ohm to ohm. Sane et al disclose in figs. 1-10 precisely defined resistance for each resistor. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to dispose metal plate having a precisely defined position for providing precisely defined resistance for each resistors, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ. As to claims 28, 29, 41 and 42, Sone et al disclose low resistance resistors could be achieved by adjusting dimensions of certain elements of the device. Robins discloses a length of a resistor of about 2.54 mm. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to use electrodes and resistors of a suitable dimensions, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the *art*. In re Aller, 105

USPQ 233.

The Examiner further rejects Claims 26 and 39 under 35 U.S.C. 103(a) as being as being unpatentable over Robbins in view of 5 Thomas et al as applied to claims 23 and 37 above, and further in view of Shimada (SIP 8-22903). According to the Examiner, the combined references fail to specifically disclose column-shaped electroplated electrode comprising a copper layer and a tin-lead alloy layer. Shimada discloses electroplated electrode comprising a 10 copper layer 7 and a tin-lead alloy layer 9. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to employ a copper layer and a tin-lead alloy layer, since that would control solder wetting degradation and improves background surface of nickel plating.

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Since these rejections are all based on the combinations of Robbins, Coates and other prior art references, and as discussed above, a combination of Robbins and Coates would not teach one to devise a 20 resistor array or resistor directed by the claims as now amended, the amended claims 15- 42 would be novel, not obvious and patentable over these cited prior references. For these reasons, the Applicants would respectfully request that the rejections of these claims based on Robbins and Coates and other cited prior art references be withdrawn.

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With the amended drawings, the canceled and amended claims, and the reasons provided above, applicants hereby respectfully request that Examiner's rejections under 37 CFR § 1.83(p)(4), and 35 USC § 112, 102 and 103 be withdrawn and the present application be allowed.

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Respectfully submitted,
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By



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

- 5 (Twice Amended) 15. A resistor array comprising:
a plurality of resistors each comprising a metallic bulk base;
10 a plurality of electrodes composed of conductive material disposed directly on said metallic bulk base for connecting each of said resistors to external circuits wherein said metallic bulk base between every two of said electrodes having a precisely controlled distance for providing a precisely defined resistance for each of said resistors.
15 (Twice Amended) 16. The resistor array of claim 15 further comprising:
at least an electrode layer of [said] a different conductive material disposed on each of said electrodes [to form an electrode for each of said electrode columns].
20 (Twice Amended) 17. The resistor array of claim 15 further comprising:
a plurality of scribing lines disposed between said resistors for scribing said resistor array into a plurality of resistors each comprising at least two electrodes for connecting each of said resistors to external circuits.
25 (Twice Amended) 18. The resistor array of claim 15 wherein:
30 said metallic bulk base [of said resistors composed of] comprising a nickel-copper alloy.

(Twice Amended) 19. The resistor array of claim 15 wherein:

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each of said electrodes further comprises a copper layer and a tin-lead alloy layer [disposed on each of said electrode columns].

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(Twice Amended) 20. The resistor array of claim 15 wherein:

said precisely defined resistance for each of said resistors ranging [between] approximately from one milli-ohm to one ohm.

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(Twice Amended) 21. The resistor array of claim 15 wherein:

said metallic bulk base of each of said plurality of resistors having a thickness ranging [between] approximately from 0.05 to 0.5 millimeters and a length ranging [between] approximately from 1.0 to 7.0 millimeters.

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(Twice Amended) 22. The resistor array of claim 15 wherein:

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each of said plurality of electrodes disposed directly on said metallic bulk base having a width and length ranging [between] approximately from 0.1 to 3.2 millimeter, a height ranging [between] approximately from 0.05 to 0.5 millimeters and distance ranging [between] approximately from 0.4 to 6.2 millimeters between every two electrode columns.

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(Twice Amended) 23. A resistor array comprising:

a plurality of resistors each comprising a metallic bulk base;

5 a plurality of column-shaped electroplated electrodes disposed directly on said metallic bulk base for connecting each of said resistors to external circuits and having a precisely controlled distance between every two of said electrodes for providing a precisely defined resistance for
10 each of said resistors.

(Twice Amended) 24. The resistor array of claim 23 further comprising:

15 a plurality of scribing lines disposed between said resistors for scribing said resistor array into a plurality of resistors each comprising at least two electrodes for connecting each of said resistors to external circuits.

20 (Twice Amended) 25. The resistor array of claim 23 wherein:

said metallic bulk base [of said resistors composed of]
comprising a nickel-copper alloy.

25 (Twice Amended) 26. The resistor array of claim 23 wherein:

each of said plurality of column-shaped electroplated electrodes disposed directly on said metallic bulk base further comprises a copper layer and a tin-lead alloy layer.

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(Twice Amended) 27. The resistor array of claim 23 wherein:

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said precisely defined resistance for each of said resistors ranging [between] approximately from one milli-ohm to one ohm.

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(Twice Amended) 28. The resistor array of claim 23 wherein:

said metallic bulk base of each of said plurality of resistors having a thickness ranging [between] approximately from 0.05 to 0.5 millimeters and a length ranging [between] approximately from 1.0 to 7.0 millimeters.

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(Twice Amended) 29. The resistor array of claim 23 wherein:

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each of said plurality of column-shaped electrodes disposed directly on said metallic bulk base having a width and length ranging [between] approximately from 0.1 to 3.2 millimeter, a height ranging [between] approximately from 0.05 to 0.5 millimeters and distance ranging [between] approximately from 0.4 to 6.2 millimeters between every two electrodes.

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(Twice Amended) 30. A resistor comprising:

a metallic bulk base;

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at least two electrodes composed of a conductive material disposed directly on said metallic bulk base for connecting said resistor to external circuits and having a precisely controlled distance between said two electrodes for providing a precisely defined resistance for said resistor.

(Twice Amended) 31. The resistor of claim 26 further comprising:

5 at least an electrode layer of [said] a different conductive material disposed on each of said electrodes [to form an electrode for each of said electrode columns].

(Twice Amended) 32. The resistor of claim 30 wherein:

10 said metallic bulk base [composed of] comprising a nickel-copper alloy.

(Twice Amended) 33. The resistor of claim 30 wherein:

15 each of said electrodes further comprises a copper layer and a tin-lead alloy layer [disposed on each of said electrode columns].

(Twice Amended) 34. The resistor of claim 30 wherein:

20 said precisely defined resistance for said resistor ranging [between] approximately from one milli-ohm to one ohm.

(Twice Amended) 35. The resistor of claim 30 wherein:

25 said metallic bulk base of said resistor having a thickness ranging [between] approximately from 0.05 to 0.5 millimeters and a length ranging [between] approximately from 1.0 to 7.0 millimeters.

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(Twice Amended) 36. The resistor of claim 30 wherein:

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each of said electrodes disposed directly on said metallic bulk base having a width and length ranging [between] approximately from 0.1 to 3.2 millimeter, a height ranging [between] approximately from 0.05 to 0.5 millimeters and distance ranging [between] approximately from 0.4 to 6.2 millimeters between every two electrode columns.

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(Twice Amended) 37. A resistor comprising:

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a metallic bulk base;
a least two column-shaped electroplated electrodes disposed directly on said metallic bulk base for connecting said resistor to external circuits and having a precisely controlled distance between said electrodes for providing a precisely defined resistance for said resistor.

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(Twice Amended) 38. The resistor of claim 37 wherein:

said metallic bulk base [of said resistor composed of]
comprising a nickel-copper alloy.

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(Twice Amended) 39. The resistor of claim 37 wherein:

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each of said column-shaped electroplated electrodes [disposed directly on said metallic bulk base] further comprises a copper layer and a tin-lead alloy layer.

(Twice Amended) 40. The resistor of claim 37 wherein:

said precisely defined resistance for said resistor ranging [between] approximately from one milli-ohm to one ohm.

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(Twice Amended) 41. The resistor of claim 37 wherein:

10 said metallic bulk base of said resistor having a thickness ranging [between] approximately from 0.05 to 0.5 millimeters and a length ranging [between] approximately from 1.0 to 7.0 millimeters.

(Twice Amended) 42. The resistor of claim 37 wherein:

15 each of said column-shaped electrodes disposed directly on said metallic bulk base having a width and length ranging [between] approximately from 0.1 to 3.2 millimeter, a height ranging [between] approximately from 0.05 to 0.5 millimeters and distance ranging [between] approximately from 0.4 to 6.2 millimeters between every two electrodes.

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